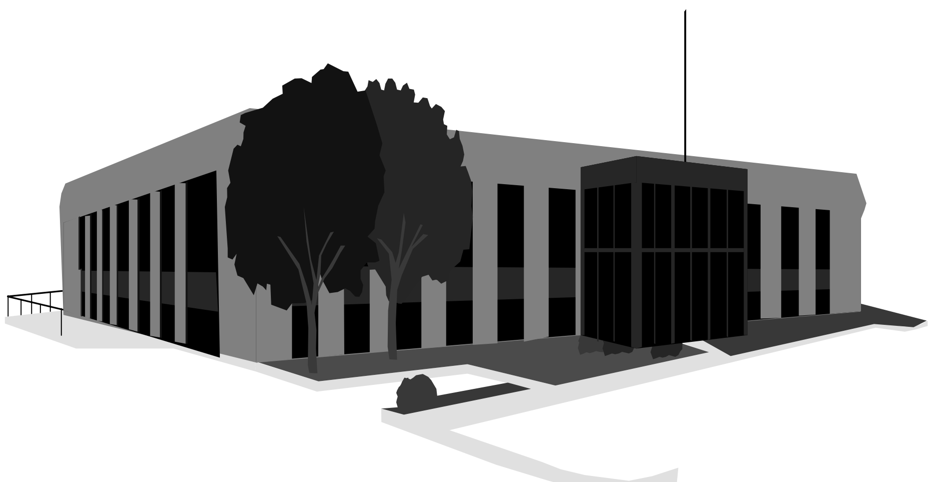
INDOOR AIR QUALITY ASSESSMENT

Massachusetts Department of Mental Health
Site Office Region II
40 Institute Road
Grafton, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
January, 2001

Background/Introduction

At the request of Bill Corliss, Massachusetts Department of Mental Health (MDMH), an indoor air quality assessment was done at the MDMH Site Office, Region II (the site office), 40 Institute Road, Grafton, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (DPH), Bureau of Environmental Health Assessment (BEHA). Employee concerns about poor indoor air quality and rodent infestation prompted the investigation. On November 7, 2000, Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), made a visit to this building. Rita Trombly of MDMH accompanied Mr. Feeney during the visit.

The site office is two-story, wood frame building on the grounds of the former Grafton State Hospital. This building appears to have been originally built as patient housing. The date of construction is estimated to be 1930-40. After Grafton State Hospital was closed, this building was designated as excess state property and remained unoccupied for several years. The MDMH site office moved into the building in 1988. Reportedly, maintenance of the grounds is currently administered by the Department of Social Services.

The floor space was originally configured into four open wards with private patient rooms and nurse's stations. Three of the four open wards are subdivided into work areas by five-foot high floor dividers. Each private patient room or nurse's station was converted into a private office. The first floor north section was divided into a waiting room, conference room, kitchen and shared office space. Windows are openable in some areas of the building. Prior to occupancy by the MDMH site office, the interior of the building was renovated. Two air handling units (AHUs) were installed at ground level at the front of the building. (see Pictures 1 and 2). Suspended ceilings were installed on both floors. The existence of a thick layer of fiberglass insulation on top of the suspended ceiling on the second floor (see Picture 3) indicates that the renovations were an energy conservation measure. A steam plant located in a separate building supplies heat for the building (see Picture 4).

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Moisture content in carpeting was measured with a Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe.

Results

These offices have an employee population of 28 with approximately one to two members of the general public visiting the space daily. The tests were taken under normal operating conditions. Test results appear in Tables 1-2.

Discussion

Ventilation

It can be seen from the tables that the carbon dioxide levels were below 800 parts per million of air (ppm) in seventeen of eighteen areas sampled, which normally indicates adequate ventilation. However, during the assessment neither AHU was operating. Even if the AHU had been operating, the fresh air intake louvers were found closed, which limits the amount of fresh air drawn into each AHU. The sole source of fresh air in the building during the assessment was air penetrating through cracks and seams in window frames and the periodic opening of exterior doors.

The heating, ventilating and air-conditioning (HVAC) system consists of several independently operating components: 1) a retrofitted mechanical ventilation system; 2) a partially abandoned natural ventilation system; and 3) baseboard heating units located in first floor offices. The two AHUs located at ground level in the front of the building provide mechanical ventilation. Each AHU is connected to ductwork above the ceiling that distributes air to ceiling mounted air diffusers. Air diffusers are designed to create airflow by directing air to move along the ceiling and walls, which allows for air to mix and to create circulation. The AHUs do not provide exhaust ventilation. Return air is drawn to each AHU by ceiling mounted exhaust vents through ductwork. Without an operating ventilation system, no fresh air can be delivered mechanically into the building.

In addition to the mechanical system, a natural ventilation system exists within the core of the building that formerly provided heating when the building was used as a patient ward. The original system provided ventilation by a series of brick air shafts and louvered vents that were connected to a room located on the first floor where steam pipes enter the building. In the center of the first floor of the building is a room that has a series of heating elements (air mixing room) (see Picture 5). These heating elements correspond to a brick airshaft that terminates in a chimney-like structure on the roof (see Picture 6). On the first floor is a vent, which is located on the wall of the air mixing room near area 99 (AIT Room) (see Picture 7). A corresponding vent that was sealed exists in a wall near area 37 (see Picture 8). Each of these vents would provide heated air from the air mixing room to first floor rooms. No corresponding vents could be located on the second floor, but are presumed to be sealed similar to the area 37 vent. Each of the open wards was constructed around these shafts to provide exhaust ventilation.

Air movement is provided by the stack effect. The heating elements warm the air, which rises up the ventilation shafts. As the heated air rises, negative pressure is created, which draws cold air from the basement area into the heating elements. A louvered or sash window located near the airshaft typically controlled fresh air in this type of system. Sash windows exist in the utility room and were sealed shut and insulated (see Picture 9). As previously mentioned, this ventilation system appears to have been abandoned. While airshaft openings were sealed, heating elements in the air mixing room were emitting heat, indicating that the system was not completely abandoned and is still receiving steam from the supply plant. These conditions would create negative pressure in this area drawing air though seams of the utility room door, resulting in the continuous re-heating of air without the introduction of fresh outdoor air.

According to building occupants, temperature control between the first and second floor is difficult. If temperature is comfortable for first floor occupants, second floor occupants report cold temperatures. If heat is raised to make the second floor occupants comfortable, the first floor occupants report hot temperatures. The configuration of the mechanical and natural ventilation systems can contribute to this lack of temperature control. The usual design for ventilation systems evaluated by BEHA staff is to provide ventilation on a horizontal plane, with each AHU distributing conditioned air to a single floor. (see Figure 1). Instead, each AHU in this building services a vertical cross-section of the building (see Figure 2), with the original natural ventilation system continuing to operate. With this design, the increase of temperature to provide heat to the second floor would result in the natural ventilation system increasing temperature into the air mixing room heating elements. With increased heat from the heating elements, warm reheated air is introduced into the first floor. Without the AHUs operating to provide fresh air to the building to temper air, increased complaints of excessive heat would be expected on the first floor.

The condition of the AHUs servicing the building may also limit operation. Each AHU was installed at the base of the front of the building, beneath the edge of the sloped roof. Building occupants report that the AHUs and ductwork were repeatedly damaged by accumulated snow sliding from the peaked roof. Several conditions confirm this report. The top cover bolts to the south AHU are a different color than the rest of the casing suggesting that they have been replaced. Sealed within the casing against the coils is a free standing filter. All routine methods for installing filters through outside access panels are of insufficient width to install a filter of the size currently installed. It appears that this filter was inserted in the casing when the new top casing cover was installed. The age of the filter could not be determined. Finally, in an effort to prevent further damage, a small roof structure was constructed over the ductwork and AHUs (see Picture 10). Whether these repairs restored each AHU to an adequate operational capacity could not be determined.

The office does not appear to be designed to have mechanical ventilation that will exhaust air from this office space. With the lack of a fresh air supply or exhaust ventilation, pollutants that exist in the interior space will not be diluted or removed and will build up and remain inside the office.

The private offices do not have air diffusers. Occupants of private offices have experienced cold temperatures. In order to improve temperature control, a heating system was installed in these rooms. The only source for fresh air in these offices appears to be openable windows or by air infiltration through the front door of this building.

In order to have proper ventilation with a mechanical supply and exhaust system, these systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings at the site office were above the BEHA recommended comfort range (ranging from 73^{o} F to 84^{o} F) in all areas of the first floor and in three out of ten areas on the second floor. The configuration and operation of the various HVAC systems in the building all contribute to lack of temperature control. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. In this particular building, temperature measurements confirm building occupant assertions of poor temperature control.

Relative humidity measurements ranged from 26 to 41 percent throughout the building, which were below the BEHA comfort range for most areas. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. Relative humidity measurements would be expected to be near or below the relative humidity outdoors. Of note were several areas on the second floor that had relative humidity measurements 2 to 8 percent higher than the relative humidity measured outdoors (33 %) on the day of the assessment. This increase of relative humidity can be attributed to a lack of airflow. Without airflow created by the mechanical ventilation system, water vapor from occupants can build up, as demonstrated by these relative humidity measurements. Relative humidity levels would be expected to drop during the heating season. The sensation of dryness and irritation is common in a low relative humidity environment. Humidity is more difficult to control during the winter heating season. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Building personnel reported that leaking condensation from the heating system in the conference room has led to chronic moisture problems in the wall-to-wall carpeting. Moisture sampling for carpeting in this area was conducted. Most areas of carpeting had non-detectable levels of moisture, however moisture measurements near the exterior wall under the heating system had moisture content measurements of 39.9 to 100 percent (saturated moisture content) (see Picture 11). Carpeting along the exterior wall in work area 7 had water stains.

Of note is the ductwork supplying air to the second floor. Each former open ward has floor-to-ceiling ductwork that delivers air to ceiling mounted fresh air diffusers mounted in the suspended ceiling. AHUs also have the capacity to provide air-conditioning during summer months. The ductwork on the second floor is not insulated, which can result in the generation of condensation on its chilled metallic surface. When warm, moist air passes over a surface that is colder than the air, water condensation can collect on the cold surface. Over time, water droplets can form, which can then drip from a suspended surface. At the base of each duct is wall-to-wall carpeting which may have become chronically moistened by condensation during summer months.

Carpeting can be susceptible to mold growth if allowed to remain moist. If mold has colonized carpeting, the addition of moisture can result in increased mold growth. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that carpeting be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If carpets are not dried within this time frame, mold growth may occur. Water-damaged carpeting cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy carpeting is not recommended.

Each duct on the second floor has a condensation pump to remove collected moisture from the ductwork (see Picture 12). The condensation pumps are connected to the drainage system by clear plastic flexible hoses (see Picture 13). The interior of these flexible hoses is coated with microbial growth (see Picture 14). As the ventilation system operates, negative pressure is created which can draw air from the drain system through these hoses and into the unit. This can be a means for microbial growth and associated odors to be drawn into each unit and distributed by the HVAC system.

Other Concerns

Building occupants report that the site office is infested with mice, chipmunks and squirrels. A number of means of ingress through the exterior walls and windows were noted around the building (see Pictures 15 and 16). Occupants reported that pesticide applicators routinely remove mouse carcasses from traps within the building. Rodent infestation can result in indoor air quality related symptoms due to materials in their wastes. Mouse urine contains a protein that is a known sensitizer (US EPA, 1992). A sensitizer is a material that can produce symptoms in sensitive individuals (e.g. running nose or skin rashes). A three-step approach is necessary to eliminate rodent infestation:

1. removal of the rodents;
2. cleaning of waste products from the interior of the building; and
3. reduction/elimination of pathways/food sources that are attracting rodents.

To eliminate exposure to allergens, rodents must be removed from the building. Please note that removal, even after cleaning, may not provide immediate relief since allergens can exist in the interior for several months after rodents are eliminated (Burge, H.A., 1995). A combination of cleaning, increase in ventilation and filtration should serve to reduce rodent associated allergens once the infestation is eliminated. Under current Massachusetts law that will go into effect November 1, 2001, the principles of integrated pest management (IPM) must be used to remove pests in state buildings (Mass Act, 2000).

Subsequent to this inspection, building occupants report that measures to close rodent access were taken prior to the removal of rodents from the interior of the building. This action reportedly resulted in rodents dying within walls and suspended ceilings after becoming trapped. Decaying rodent carcasses create an extremely unpleasant odor. Since rodents are located within walls away from building occupants, they would not be expected to serve as a source of disease. However, rodent carcass odors can render the workspace difficult to work in and may cause various symptoms, (e.g. headache, nausea). The duration of odors depends on several factors: size of the rodent, number of rodent carcasses, location of the carcasses and amount of ventilation in the building. A mouse can produce odors until mummified for several days. A squirrel carcass may produce odors for several weeks after death.

There are various methods to reduce rodent carcass odors in this building. The one sure way would be to remove carcasses from ceiling and walls. This solution may be extremely difficult, since it would require the destruction of internal plaster wall to gain access to wall cavities, which in turn could create different opportunities for indoor air quality problems associated with renovations. The application of ozone generators to deodorize the interior space may have some success. However, this method may be of limited use since it would be difficult to prevent the migration of ozone into wall cavities where carcasses would be located. Increasing airflow through the ventilation system to dilute/remove odors is a third option. Without adequate exhaust ventilation, odors would be expected to continue within this office space for several weeks after all trapped rodents have expired. Alternatively, if feasible, another option may be to temporarily relocate building occupants until odors abate.

Building occupants reported that renovations to the office's heating system were planned. Control measures to prevent renovation/construction generated pollutants from migrating into occupied areas of the building were previously recommended (MDPH, 2000). This correspondence is included with this report as Appendix A.

As noted previously, the interior of the AHU contained a filter leaning against the coils. The purpose of filters is to trap particulate matter from air drawn into the AHU through fresh air intake and return vents. If filters have spaces around them or do not fit flush in filter racks, air and particulates can by-pass filters. Unfiltered air can result in particulates being distributed by the ventilation system. In this case, the filter is not in any rack and has not been changed since the repair of this AHU. In the condition noted, each AHU essentially operates without proper filtration. Without changing filters on a regular basis, the filters themselves become saturated with dust/dirt and may serve to re-aerosolize and distribute pollutants to occupied areas via the ventilation system.

AHUs are normally equipped with filters that strain particulates from airflow. The filters provide filtration of respirable dusts. In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent (Minimum Efficiency Reporting Value equal to 9) would be sufficient to reduce many airborne particulates (Thornburg, D., 2000; MEHRC, 1997; ASHRAE, 1992). Note that increasing filtration can reduce airflow (called pressure drop) which can reduce the efficiency of the AHUs due to increased resistance. Prior to any increase of filtration, each AHU should be evaluated by a ventilation engineer to ascertain whether it can maintain function with more efficient filters.

Rest rooms on the second floor have exhaust vents that eject air into the attic space. Normally, rest room vents eject exhaust air directly outdoors through an opening in the roof. In this configuration, odors and water vapor from restrooms can accumulate in the attic space.

Missing ceiling tiles were observed in several areas throughout the building. Missing ceiling tiles can provide a pathway for the movement of odors, fumes, dusts and vapors into occupied areas.

Conclusions/Recommendations

The conditions found in the site office present a series of problems that require a variety of remedial steps. Without HVAC equipment functioning, the lack of fresh air and mechanical exhaust results in minimal air exchange in the site office. The current design of the ventilation system does not appear to be able to remove environmental pollutants from the building. Complicating matters are the reports of cadaver odors from rodent die-off created by sealing potential exits. Under these circumstances, working conditions in this building would be difficult without odor relief from decaying rodent carcasses. If ventilation and ozone treatment fail, temporary relocation of workers from the building until odors dissipate may be the only viable option. Aside from rodent odors, a number of conditions within the site office can result in a degradation of the indoor air quality of this building. For this reason a two-phase approach is required, consisting of immediate **short-term** measures to improve air quality and **long-**

term measures that will require planning and resources to adequately address the overall indoor air quality concerns within this office.

In view of the findings at the time of this visit, the following **short-term** recommendations are made:

1. Consider consulting a disaster remediation consultant concerning rodent carcass odor remediation.
2. It is highly recommended that the principles of integrated pest management (IPM) be used to rid this building of pests. A copy of the IPM recommendations are included with this report as Appendix B (MDFA, 1996). Activities that can be used to eliminate pest infestation may include the following activities.
   a) Clean the floor behind the refrigerator.
   b) Rinse out recycled food containers. Seal recycled containers in a tight fitting lid to prevent rodent access.
   c) Remove non-food items that rodents are consuming (e.g. materials that contain cellulose).
   d) Store foods in tight fitting containers.
   e) Avoid eating at workstations. In areas were food is consumed, periodic vacuuming to remove crumbs is recommended.
   f) Regularly clean crumbs and other food residues from toasters, toaster ovens, microwave ovens, coffee pots and other food preparation equipment.
   g) Holes as small as ¼" provide enough space for rodents to enter an area. Examine each room and the exterior walls of the building for means of rodent egress and seal. If doors do not seal at the bottom, install a weather strip as a barrier to rodents

h) Reduce harborages (cardboard boxes) where rodents may reside.

3. Operate HVAC systems during periods of occupancy. Consider having the mechanical fresh air supply and exhaust balanced by an HVAC engineer. Increase the percentage of fresh air if necessary.
4. Once operating, have the ventilation system balanced.
5. Repair leaks from the heating system that is moistening carpeting.
6. Remove water damaged carpeting along walls on the first floor. Remove carpeting along the base of the floor to ceiling ducts in the second floor.
7. Replace missing ceiling tiles.
8. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations). Consider obtaining a vacuum cleaner equipped with a high efficiency particulate arrestance (HEPA) filter to trap respirable dusts.
9. Replace plastic hose for condensation drains.
10. Remove filters from the interior of AHU. Install filters in AHUs filter racks. If no racks exist in the AHUs, examine the feasibility of installing filter racks that allow for proper filtration of air and ease of filter replacement.

The following **long-term** measures should be considered.

1. Continue with plans to renovate the heating system.

2. As part of the renovation, ensure that the heating elements in the air mixing room are deactivated for better temperature control.

3. Examine the feasibility of installing general mechanical exhaust ventilation.

4. Consideration should be given to reconfiguring the ventilation system ductwork so that each AHU services one horizontal floor in order to better control heating.

5. To decrease condensation in ductwork during summer months, consider insulating the exterior of ducts.

6. Examine the feasibility of extending restroom exhaust vent out the wall of the building.

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Figure 1 **Usual Configuration of Heating Zones**

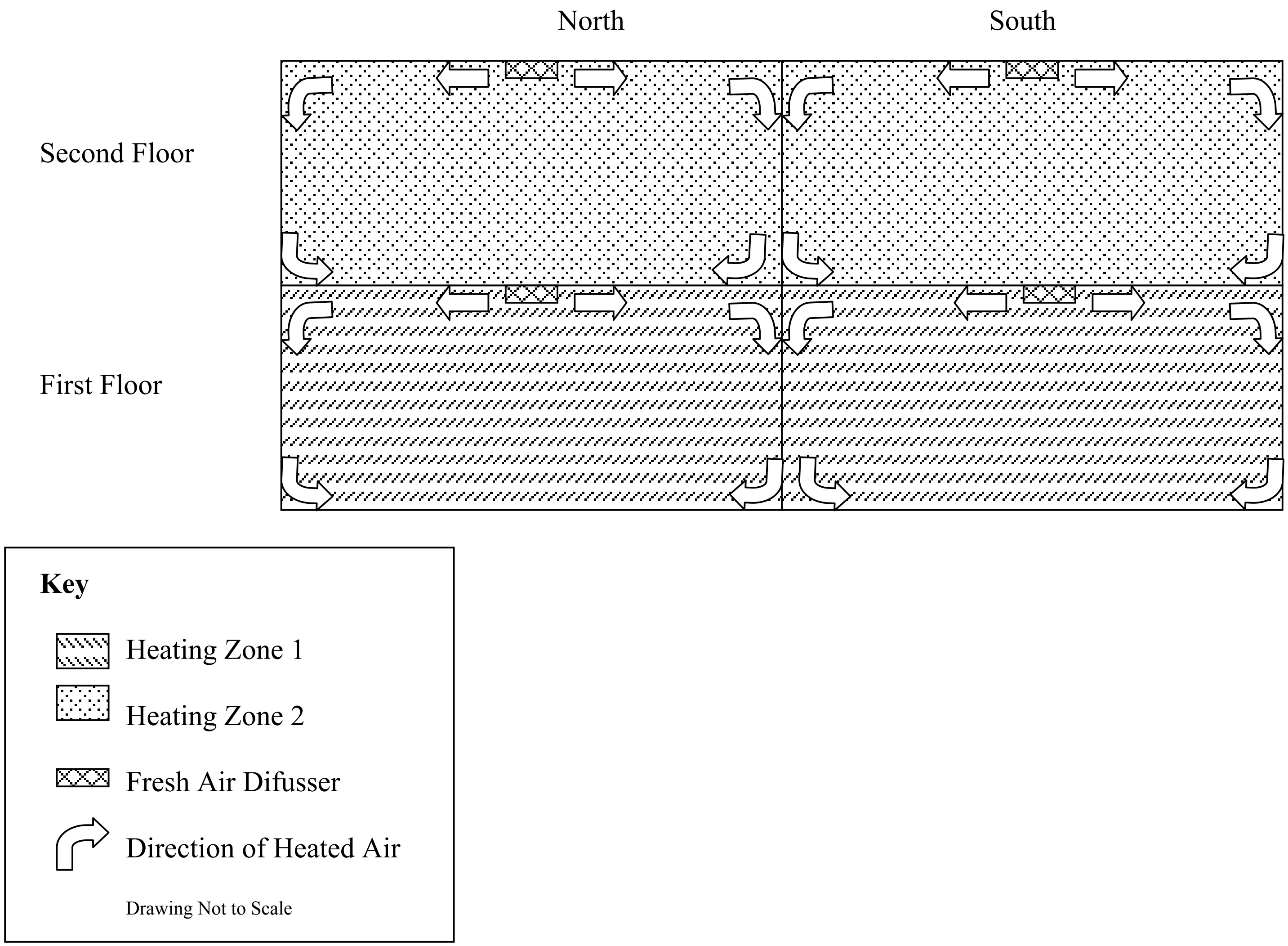
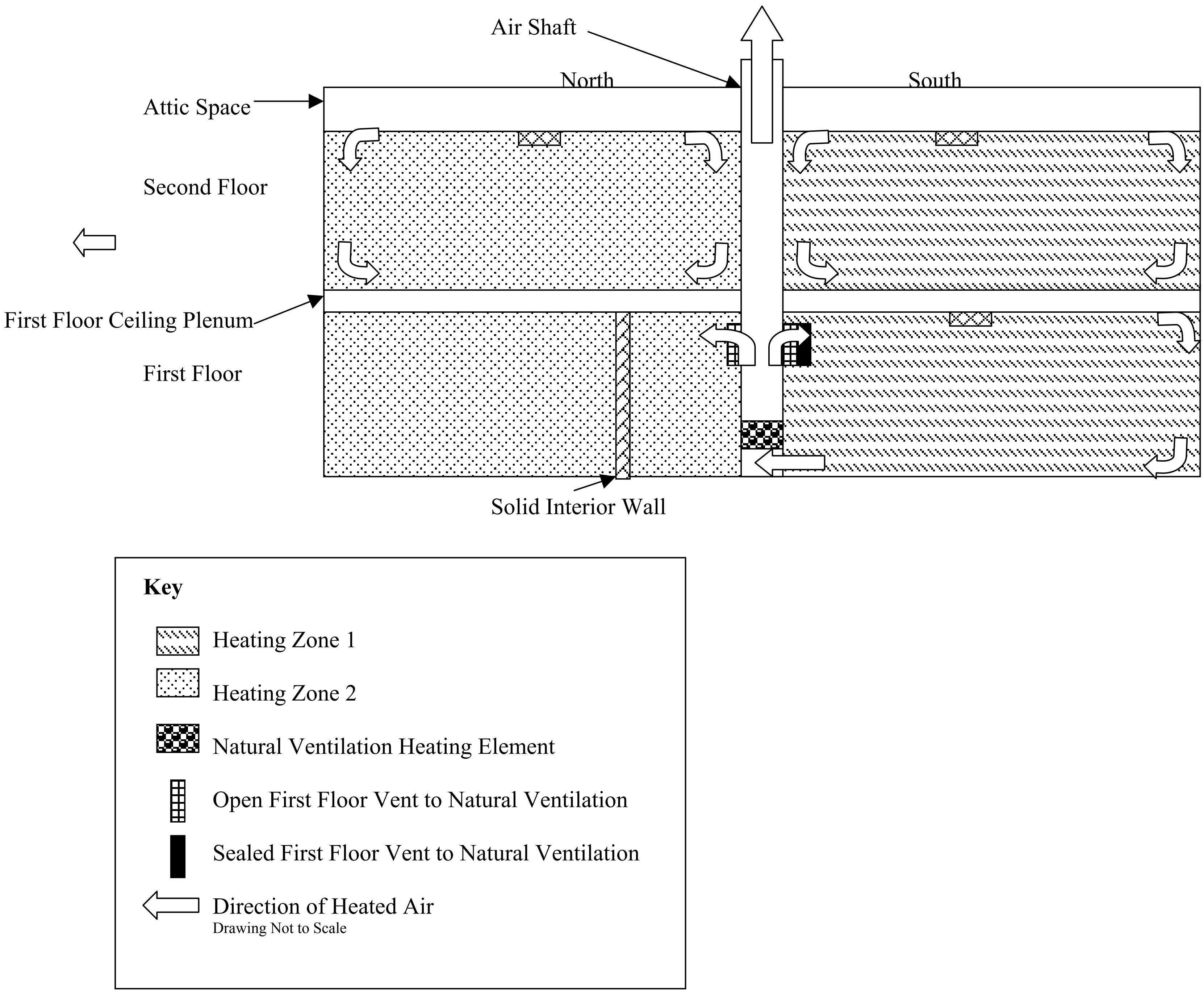


Figure 2 **Configuration of Heating Zones in MDMH Office**



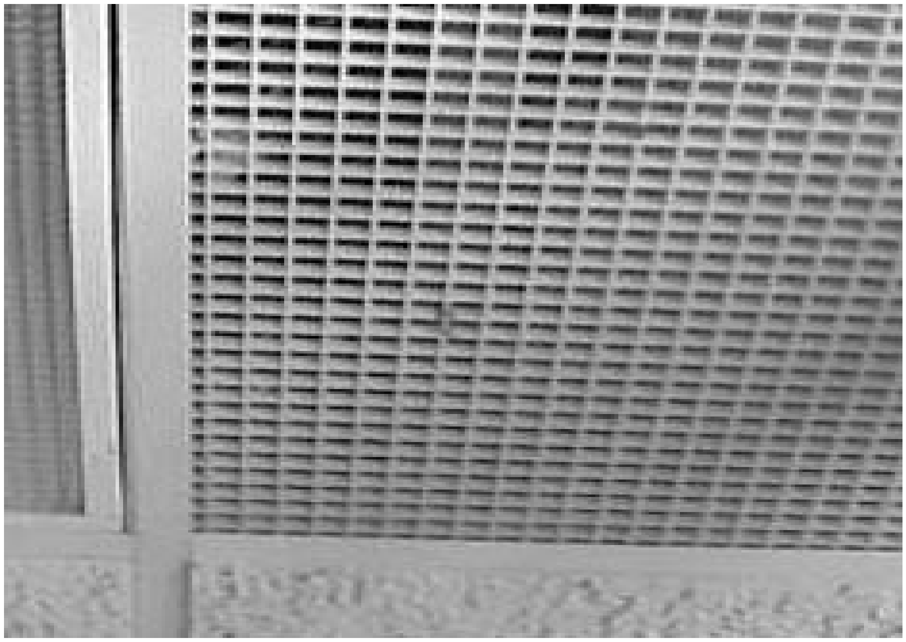
Picture 1

AHU Servicing North Zone of Building

Picture 2

AHU Servicing South Zone Of Building

Picture 3



Passive Vent Open To Suspended Ceiling and Fiberglass Insulation

Picture 4

Site Office Building Steam Plant

Picture 5

Heating Elements in Air Mixing Room

Picture 6

Terminus of Brick Airshaft on the Center of the Roof

Picture 7

Vent In Wall Of The Air Mixing Room Near Area 99 (AIT Room)

Picture 8

Sealed Vent in Wall near Area 37

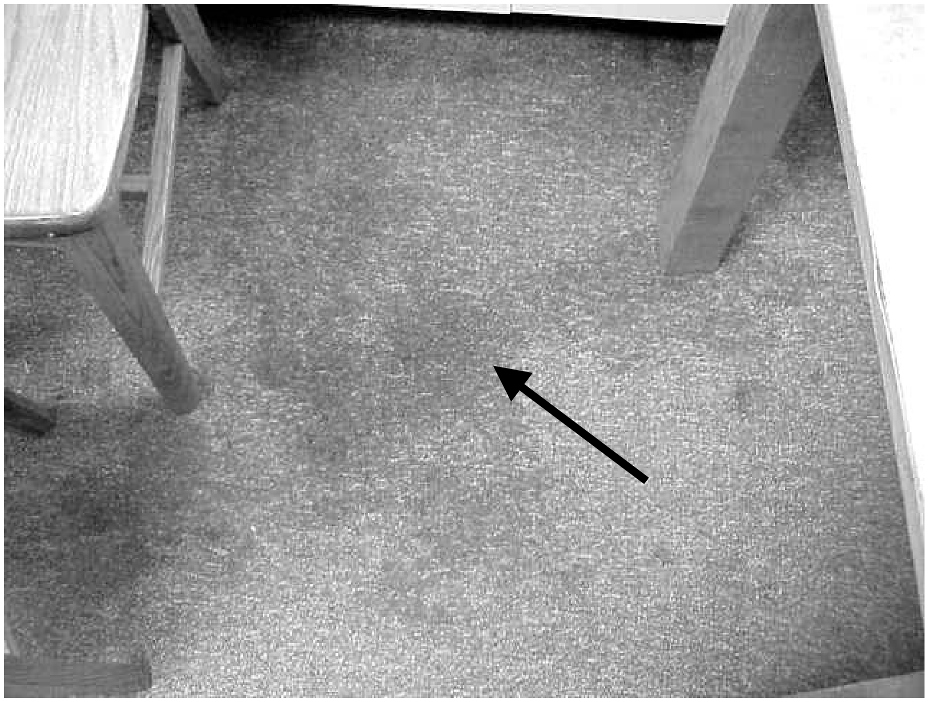
Picture 9

Sash Window in the Utility Room Sealed with Insulation

Picture 10

Small Roof Structure Constructed Over Ductwork and AHU

Picture 11



Water Saturated Carpet in Meeting Room

Picture 12

Condensation Pump To Remove Collected Moisture From The Ductwork

Picture 13

Clear Plastic Flexible Hoses Connected to Condensation Pump

Picture 14

Means Of Ingress through the Exterior Wall

Picture 15

Means Of Ingress through the Exterior Wall

TABLE 1

Indoor Air Test Results – Massachusetts Department of Mental Health, Central Office, Grafton, MA
November 7, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	451	60	33					
Trombi-3	608	84	26	0	Yes	Yes	No	Supply off, door open
McNamara-4	658	84	26	1	Yes	Yes	No	Supply off, door open
SE Corner Office-48	599	83	26	0	Yes	Yes	No	Supply off, door open
SW Corner-46	654	83	27	0	No	Yes	Yes	Supply off
44	625	83	27	1	No	Yes	Yes	Supply off, next to air mixing room, discolored carpet-from leak
Chiancola Office-27	722	83	30	1	No	Yes	No	Supply off, humidifier
Break Room	932	82	30	5	Yes	Yes	No	Supply off, refrigerator
Reception-2	571	82	26	1	Yes	Yes	Yes	Supply off, hole in ceiling tile
Conference Room-9	594	81	29	1	Yes	Yes	Yes	Supply off, door open, wet rug-measured 38.9%-100% moisture content

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results – Massachusetts Department of Mental Health, Central Office, Grafton, MA November 7, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
9	740	73	41	0	No	Yes	Yes	
13	725	74	38	1	Yes	No	No	Window and door open, respiratory complaints
11	743	75	35	0	Yes	No	No	Door open
21	736	75	34	1	Yes	Yes	Yes	Supply and exhaust off
24	619	76	33	0	Yes	Yes	Yes	Supply and exhaust off
27	599	78	33	0	Yes	Yes	Yes	Supply and exhaust off
15	706	79	33	0	Yes	No	No	Door open
17	655	79	32	0	No	Yes	Yes	Supply and exhaust off
14	660	79	31	0	Yes	No	No	

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
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Appendix A

The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
Bureau of Environmental Health Assessment
250 Washington Street, Boston, MA 02108-4619

November 28, 2000

Bill Corliss
Massachusetts Department of Mental Health
Central Office
25 Staniford Street
Boston, MA

Dear Mr. Corliss:

At your request, the Bureau of Environmental Health Assessment (BEHA) conducted an evaluation of the indoor air quality at the Massachusetts Department of Mental Health (DMH), South Worcester Local Service Site, 40 Institute Road, Grafton, MA on November 7, 2000. Michael Feeney, Chief of the Emergency Response/Indoor Air Quality (ER/IAQ) program, conducted the assessment. Mr. Feeney was accompanied by Rita Trombley, DMH and for portions of the assessment by Susan Sciaraffa-Carey, Site Director, DMH. During the course of this assessment, DMH personnel reported that replacement of the building's heating system is planned (C.A. Crowley Engineering, 1998). The heating system replacement would include capping of the existing steam pipes in the mechanical room on the ground floor and the installation of a boiler in this general area. These renovations would entail at a minimum :

1. the destruction/removal of masonry in the mechanical room,
2. the installation of piping requiring welding, and
3. excavation around the foundation.

Each of these activities will likely produce irritating dusts, fumes, vapors and gasses. These activities are planned to be done while the building remained occupied. Due to the configuration of the building, the condition of the heating, ventilating and air-conditioning (HVAC) system, and location of DMH employees in close proximity to the mechanical room first floor, it is likely that pollutants generated during the heating system renovation will likely to enter the occupied spaces of both floors of the building.

In order to prevent renovations from impacting DMH employees, the following recommendations should be implemented in order to reduce the migration of renovation generated pollutants into occupied areas:

1. Relocate employees in the immediate area of the mechanical room to other space within the building until renovations are complete.

2. Establish communications between all parties involved with building renovations to prevent potential IAQ problems. Develop a forum for occupants to express concerns about renovations as well as a program to resolve IAQ issues.

3. Develop a notification system for building occupants immediately adjacent to construction activities to report construction/renovation related odors and/or dusts problems to the building administrator. Have these concerns relayed to the contractor in a manner to allow for a timely remediation of the problem.

4. When possible, schedule projects which produce large amounts of dusts, odors and emissions during unoccupied periods or periods of low occupancy.

5. Disseminate scheduling itinerary to all affected parties, this can be done in the form of meetings, newsletters or weekly bulletins.

6. Obtain Material Safety Data Sheets (MSDS) for all construction materials used during renovations and keep them in an area that is accessible to all individuals during periods of building operations as required by the Massachusetts Right-To-Know Act (MGL, 1983).

7. Consult MSDS' for any material applied to the effected area during renovation(s) including any sealant, carpet adhesive, tile mastic, flooring and/or roofing materials. Provide proper ventilation and allow sufficient curing time as per the manufacturer's instructions concerning these materials.

8. Use local exhaust ventilation and isolation techniques to control for renovation pollutants. Precautions should be taken to avoid the re-entrainment of these materials into the building's HVAC system. The design of each system must be assessed to determine how it may be impacted by renovation activities. Specific HVAC protection requirements pertain to the return, central filtration and supply components of the ventilation system. This may entail shutting down systems (when possible) during periods of heavy construction and demolition, ensuring systems are isolated from contaminated environments, sealing ventilation openings with plastic and utilizing filters with a higher dust spot efficiency where needed (SMACNA, 1995).

9. Seal utility holes, HVAC system vents, spaces in roof decking and temporary walls to eliminate pollutant paths of migration. Seal holes created by missing tiles in ceiling temporarily to prevent renovation pollutant migration.

10. Seal construction barriers with polyethylene plastic and duct tape to create a secondary barrier to prevent migration of renovation generated pollutants into occupied areas.

11. Use a waterproof plastic mat over carpeting as a pathway leading from the renovation area in order to prevent dust transfer from shoes and aid in cleaning/dust control.

12. If possible, relocate susceptible persons and those with pre-existing medical conditions (e.g., hypersensitivity, asthma) away from areas of renovations until they are completed.

13. Implement prudent housekeeping and work site practices to minimize exposure to renovation pollutants. This may include constructing barriers, sealing off areas, and temporarily relocating furniture and supplies. To control for dusts, a high efficiency particulate air filter (HEPA) equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended.

14. Close windows adjacent to construction activities to prevent unfiltered air from entering the building.

We generally suggest that these steps be taken on any renovation project within a public building. Please feel free to contact us at (617) 624-5757 if you are in need of further information or technical assistance.

Sincerely,

Suzanne Condon, Assistant Commissioner
Bureau of Environmental Health Assessment

cc/ Mike Feeney, Chief, Emergency Response/Indoor Air Quality
Susan Sciaraffa-Carey, Site Director, DMH
Rita Trombley, DMH

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